



Podľa čoho si vyberať dodávateľa biometrického softvéru

Výsledky "majstrovstiev sveta" v identifikácii podľa odtlačkov prstov

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FpVTE

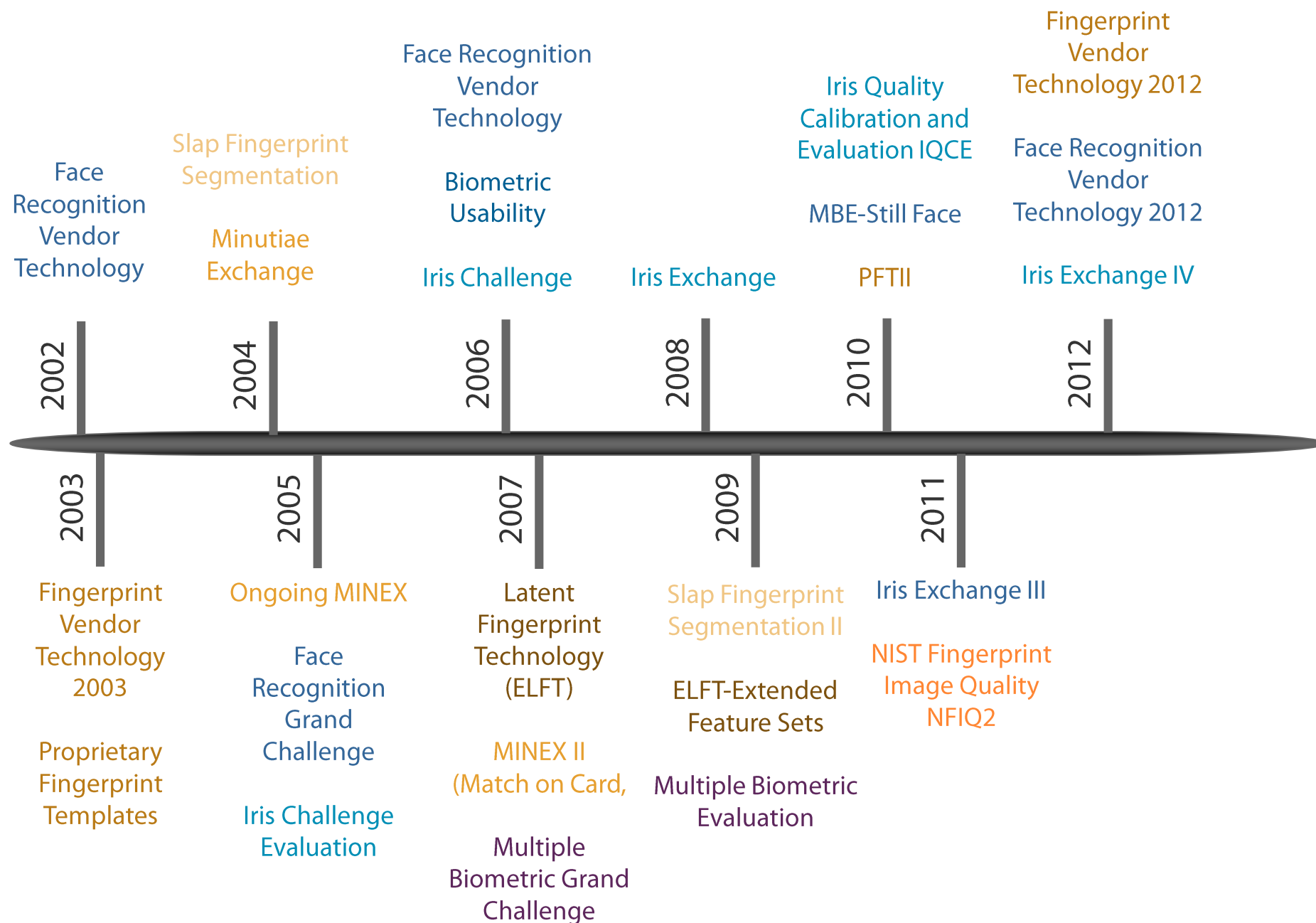
- Description
- Testing Scenarios
- Participation

Results

- Metrics
- Class of Participation
- Number of Fingers
- Search Time
- Template Size / RAM Used
- Theoretical Use Case

- Automated fingerprint identification developed since early 60'
- After 9/11, biometrics seen as emerging security technology

Biometric Evaluation at NIST



- Real world view of one-to-many identification:
 - accuracy versus speed, template size, number of fingers, enrollment set sizes, and computational resources
- Generic testing frame work and analysis tools for large scale 1-to-many biometric evaluations that can be applied to other biometrics

Testing Scenarios

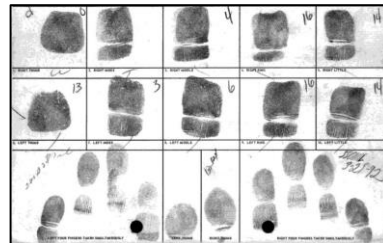
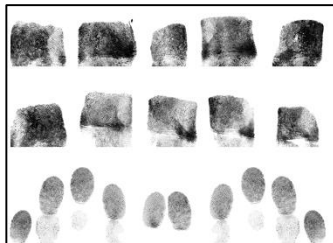
- Class A: Single finger captures (no segmentation)



- Class B: ID Flats (4-4-2, segmentation required)



- Class C: Roll and Plain capture (4-4-1-1, segmentation)



Testing Scenarios

- Class A: Single finger captures (no segmentation)

1.6M



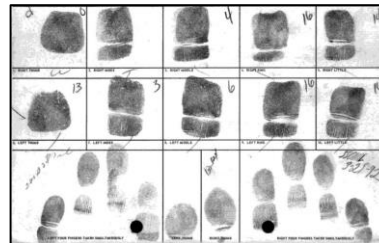
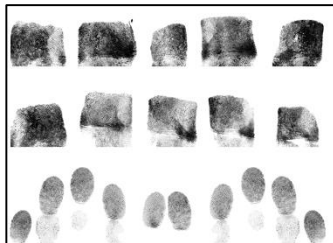
- Class B: ID Flats (4-4-2, segmentation required)

3M



- Class C: Roll and Plain capture (4-4-1-1, segmentation)

5M



1:N Identification

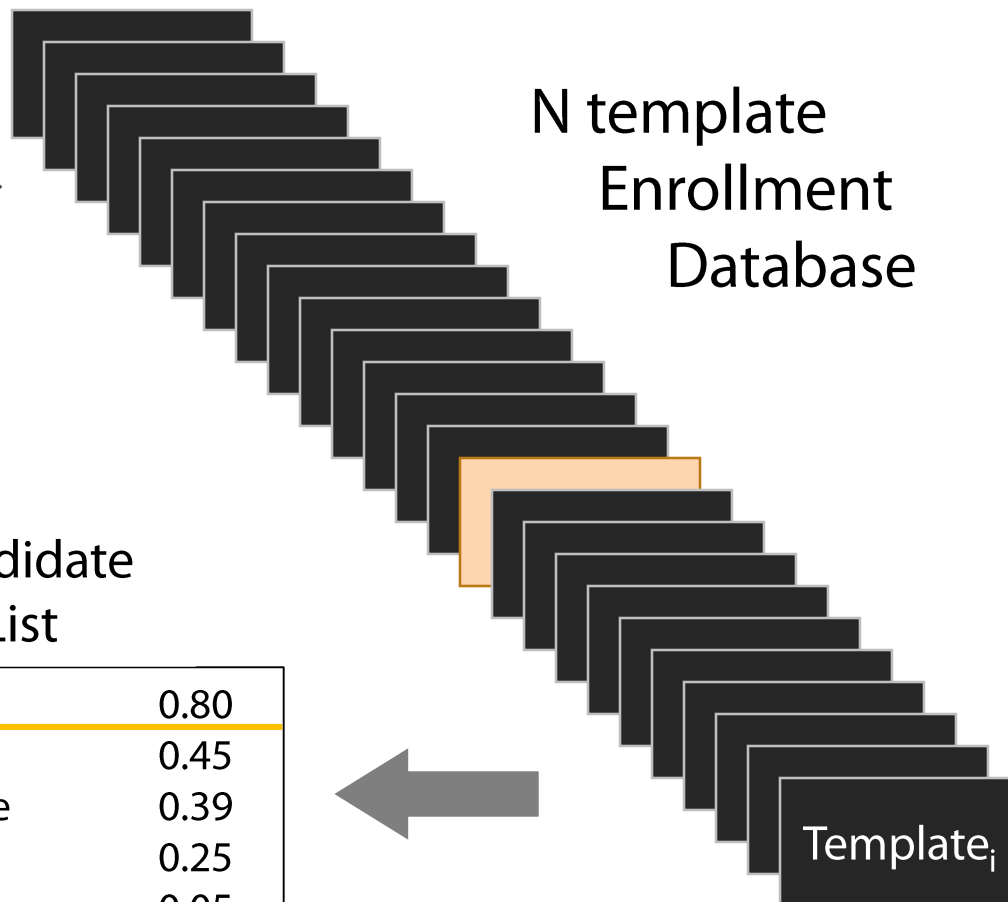
Input
Sample



Search
Template



N template
Enrollment
Database

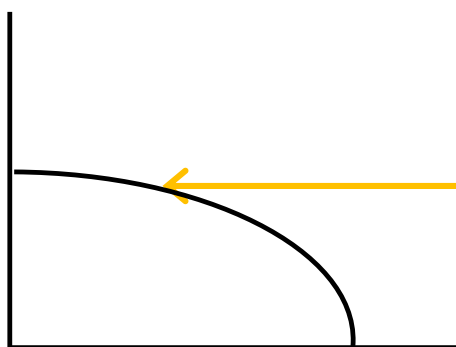


Candidate
List

1. Alice	0.80
2. Bob	0.45
3. Christophe	0.39
4. David	0.25
5. Ernie	0.05



FNIR, aka "Miss Rate"



FPIR

Aka "False Alarm Rate"

- ID3
- Innovatrics
- Aware
- SPEX
- AA Technology
- Hisign Institute
- Decatur
- Sonda
- Bio-Key
- 3M/Cogent
- Papillon
- IDSOL
- AFIS Team
- Morpho
- NEC
- Tiger IT
- Neurotechnology
- Dermalog

- **False Negative Identification Rate (FNIR)**
 - aka “**Miss Rate**”
 - Complement is the “hit rate” properly known as the true positive identification rate, which is $1 - \text{FNIR}$
- Measured by executing “mated” searches into an enrolled database of N identities

$$\text{FNIR}(N, R, T, L) = \frac{\text{Number of mates outside top } R \text{ ranks or below threshold } T \text{ on candidate list length } L}{\text{Number of mated searches conducted}}$$

- **False Positive Identification Rate (FPIR)**
 - aka “**False Alarm Rate**”, “**False Alert Rate**”
 - (related to selectivity)
- Measured by executing “non-mated” searches into an enrolled database of N identities

$$\text{FPIR}(N, T, L) = \frac{\text{Number of searches with any non-mates returned above threshold } T \text{ on candidate list length } L}{\text{Number of non-mated searches conducted}}$$



Results for each Class

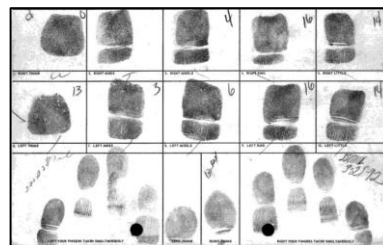
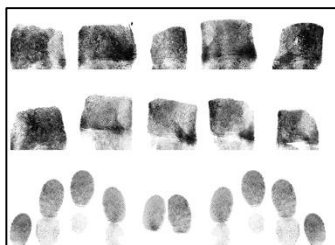
- Class A: Single finger captures (no segmentation)

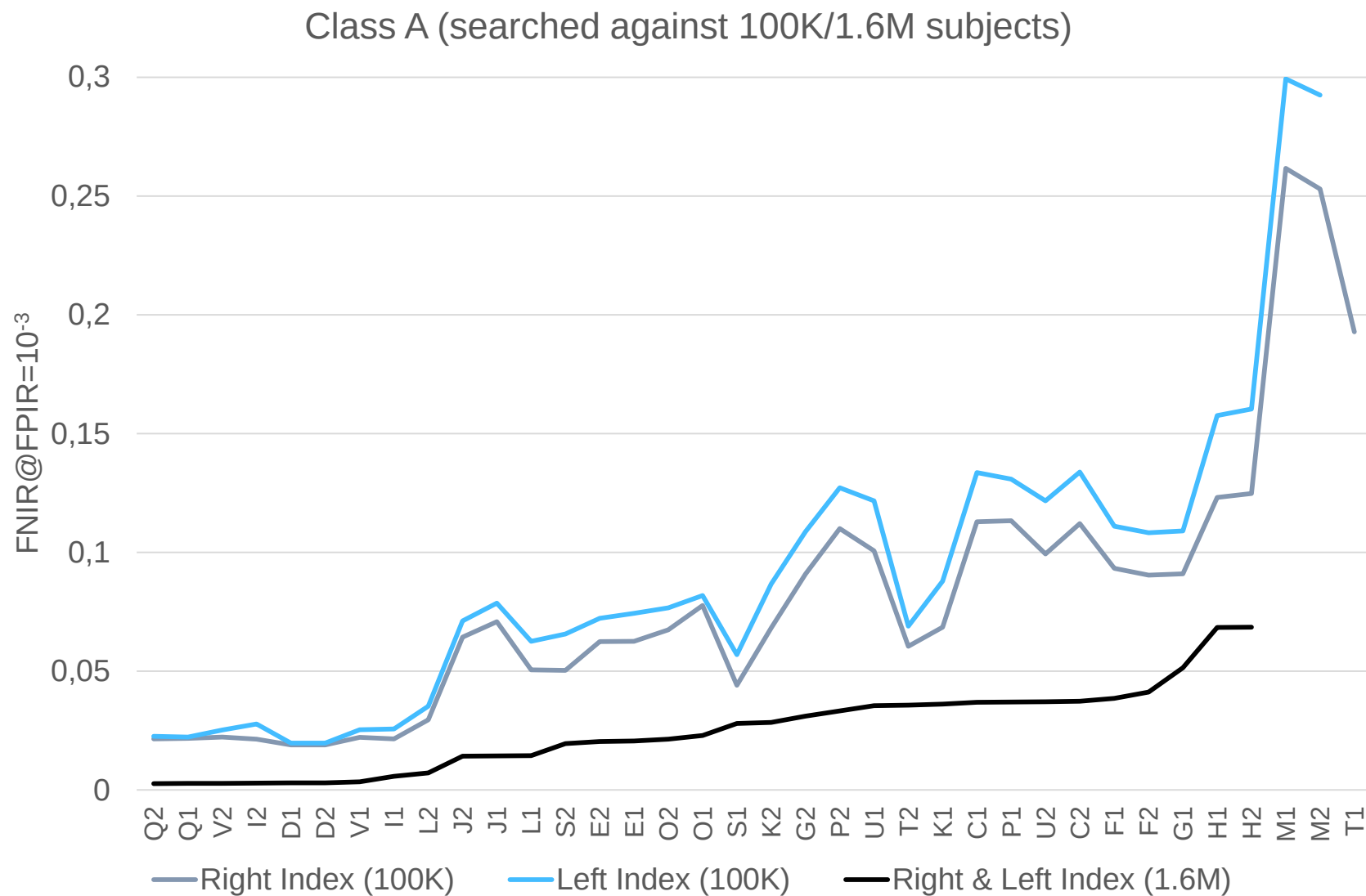


- Class B: ID Flats (4-4-2, segmentation required)



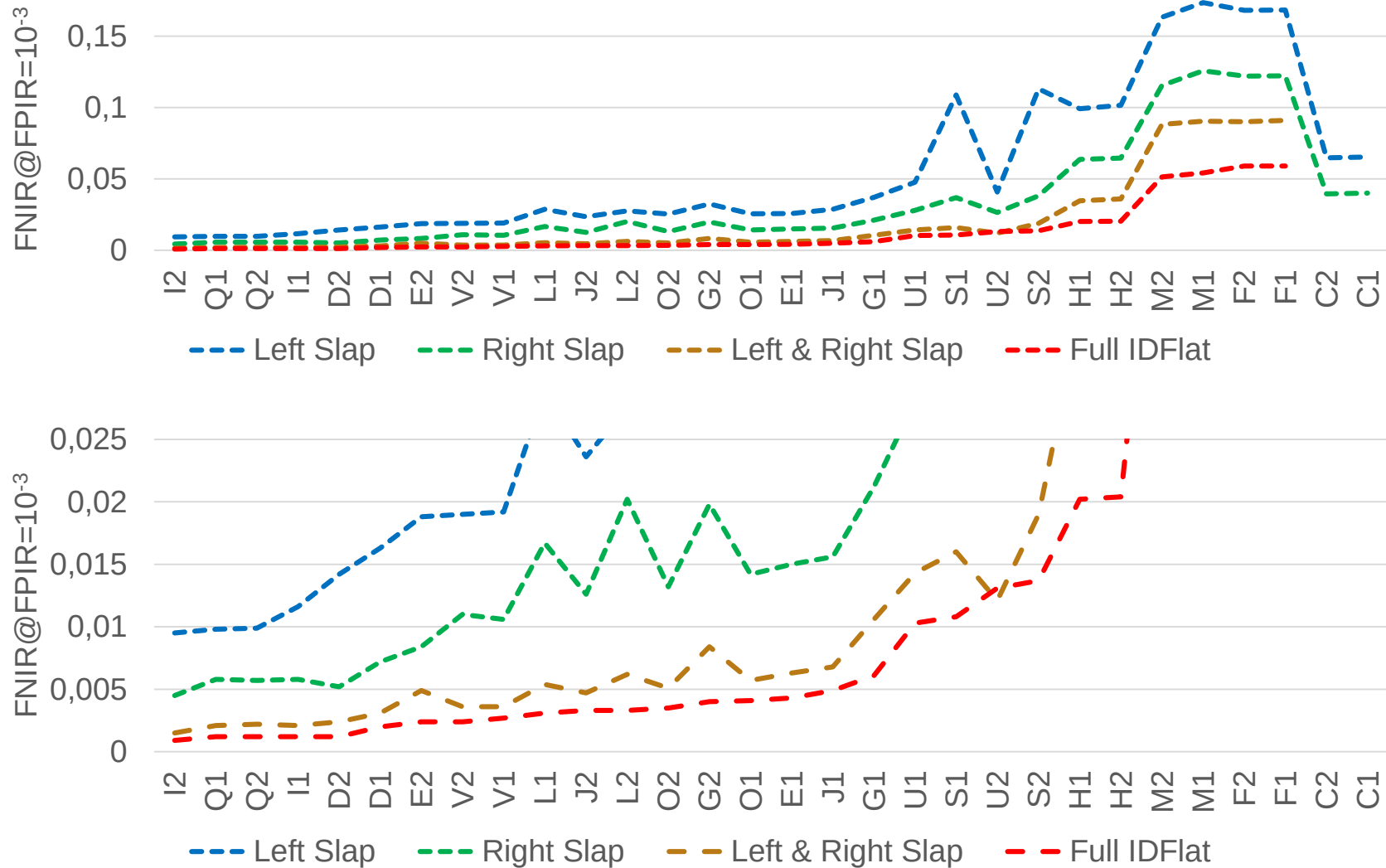
- Class C: Roll and Plain capture (4-4-1-1, segmentation)





Data Source: FpVTE 2012 report, Table 7, 8, 9

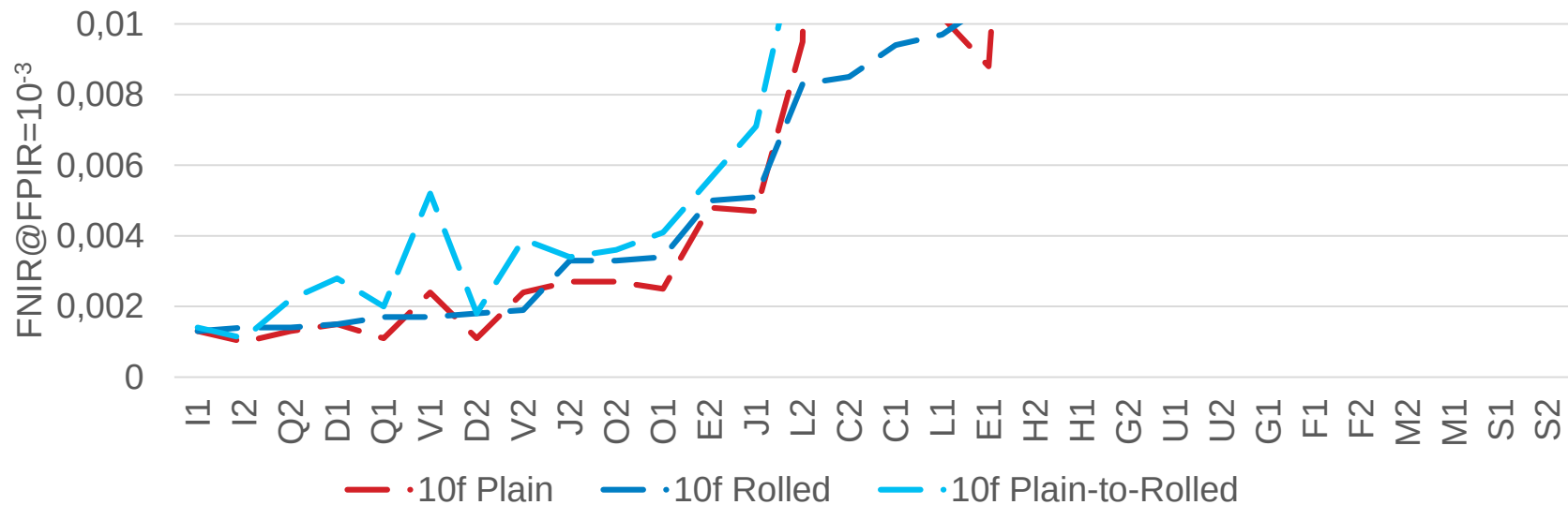
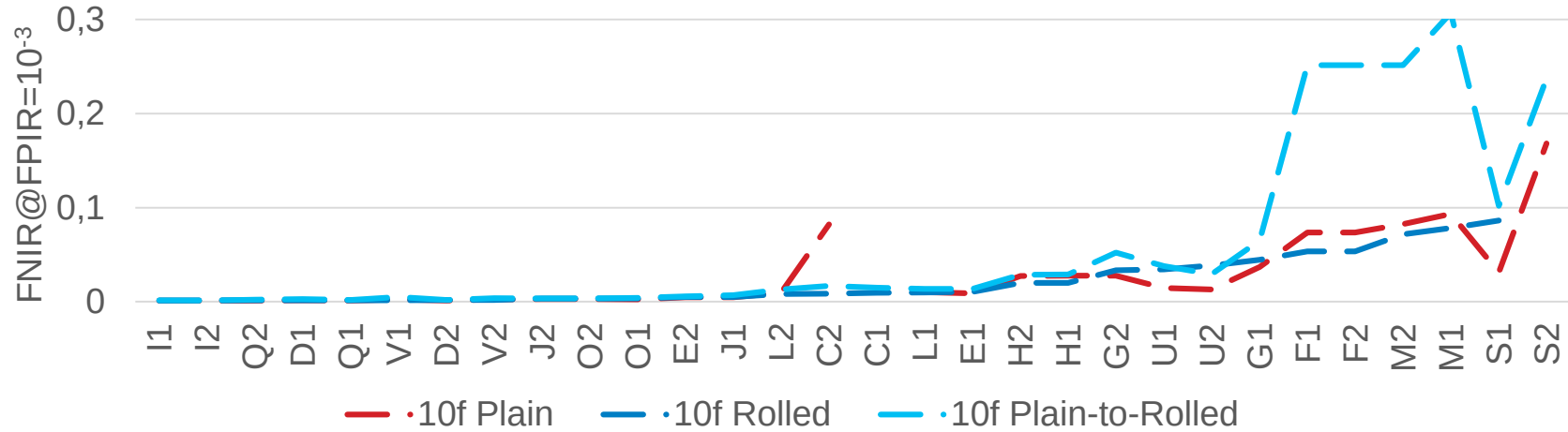
Class B (searched against 3 million subjects)



Data Source: FpVTE 2012 report, Table 10, 11, 12, 13



Class C (searched against 5 million subjects)

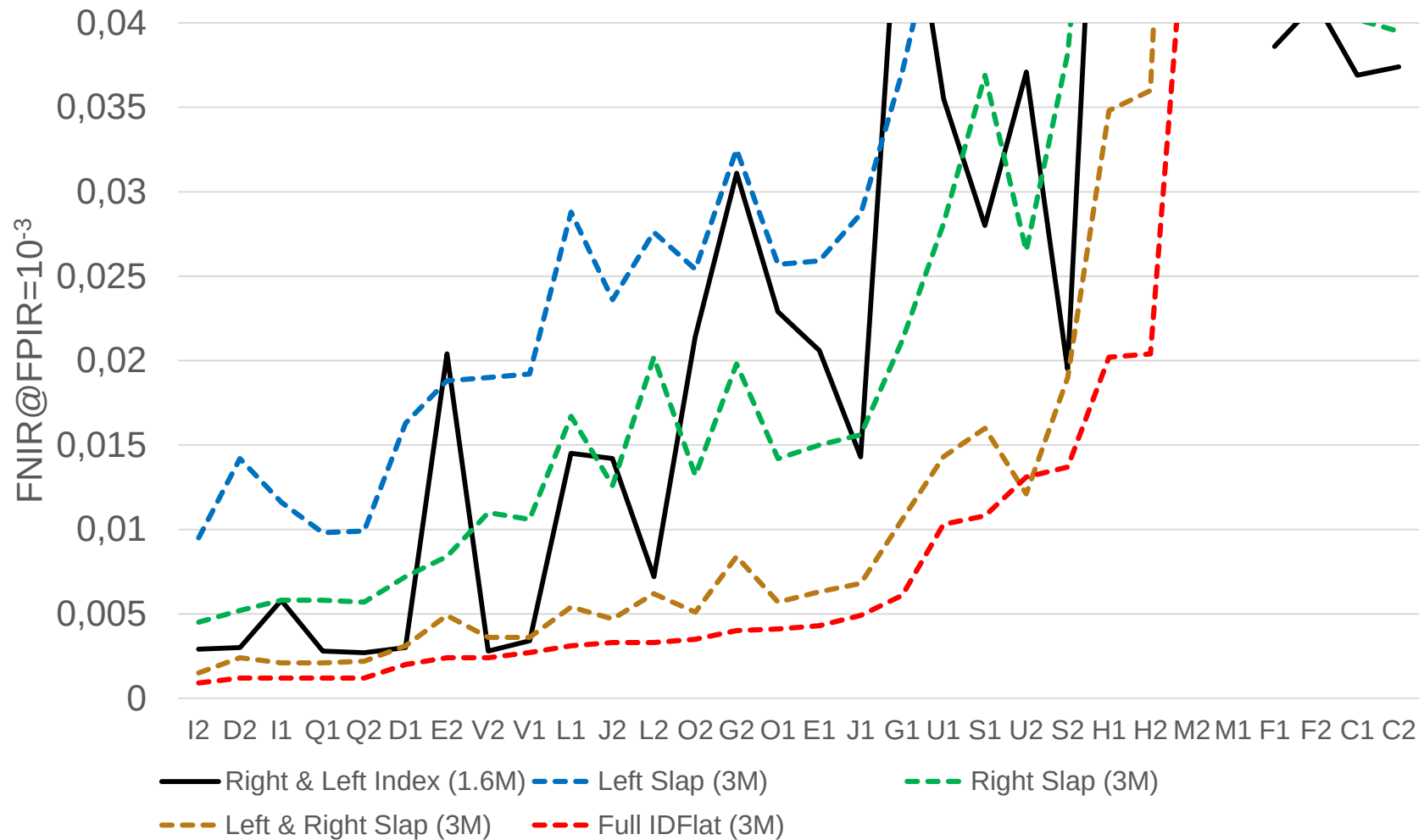


Data Source: FpVTE 2012 report, Table 14, 15, 16



Number of Fingers

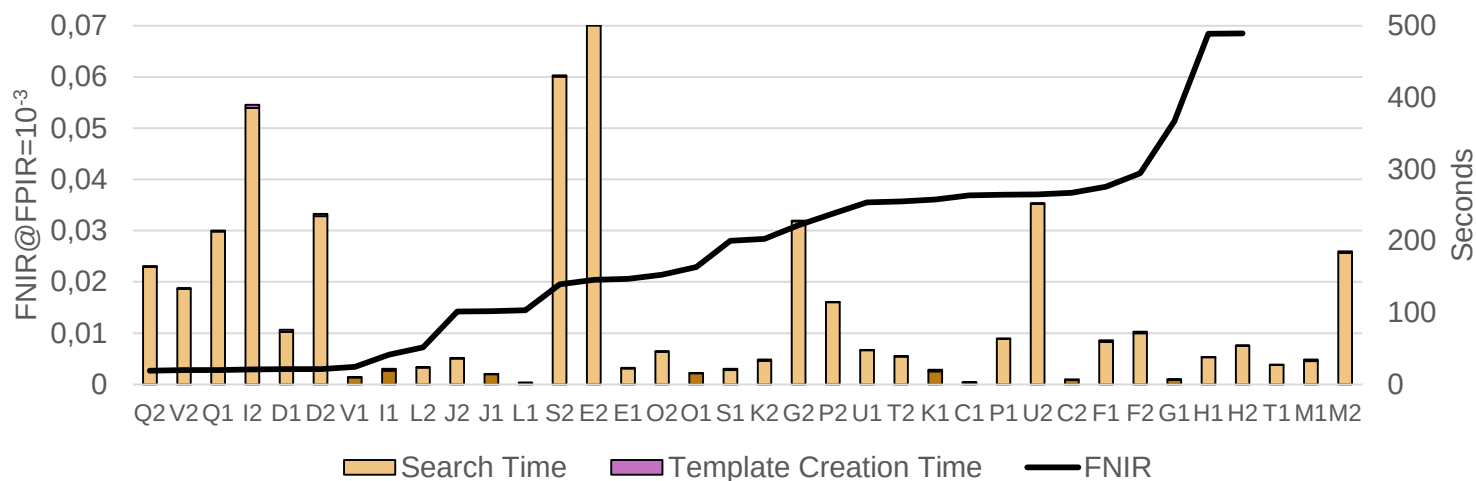
Two, Four, Eight, and Ten Fingers



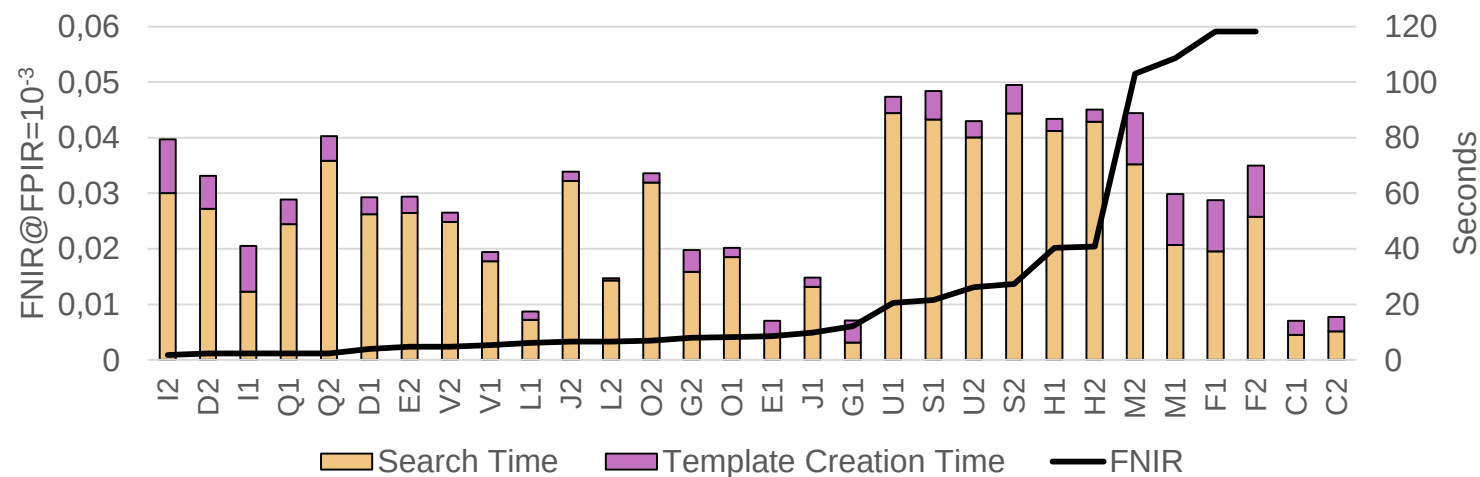
Data Source: FpVTE 2012 report, Table 9, 10, 11, 12, 13

Search Time and Template Creation Time

Class A - Two finger (searched against 1.6 million subjects)



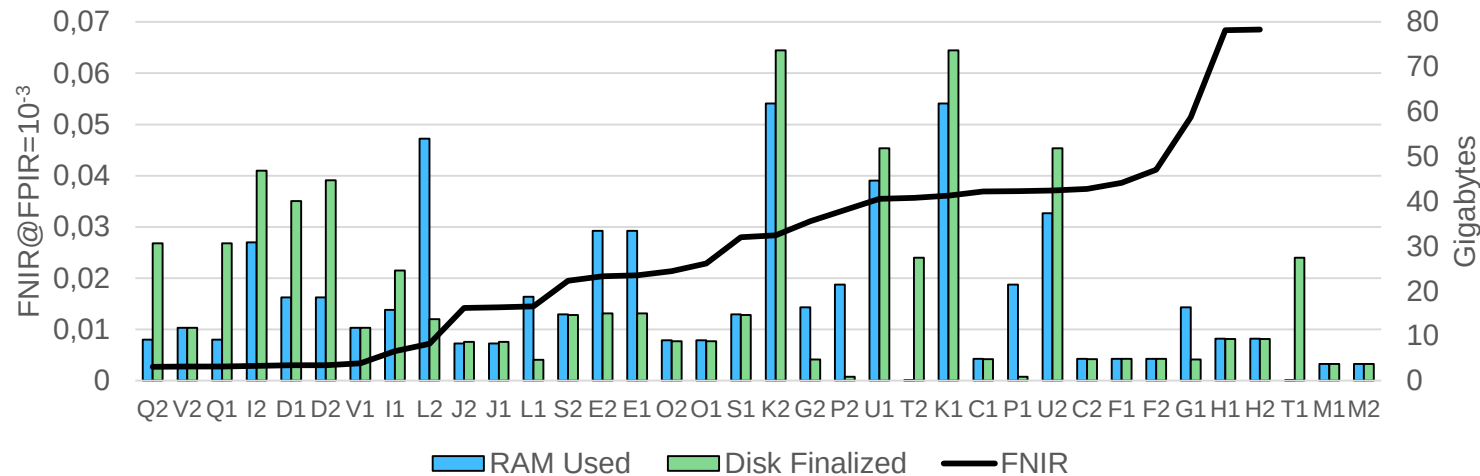
Class B - Ten finger IDFlats (searched against 3 million subjects)



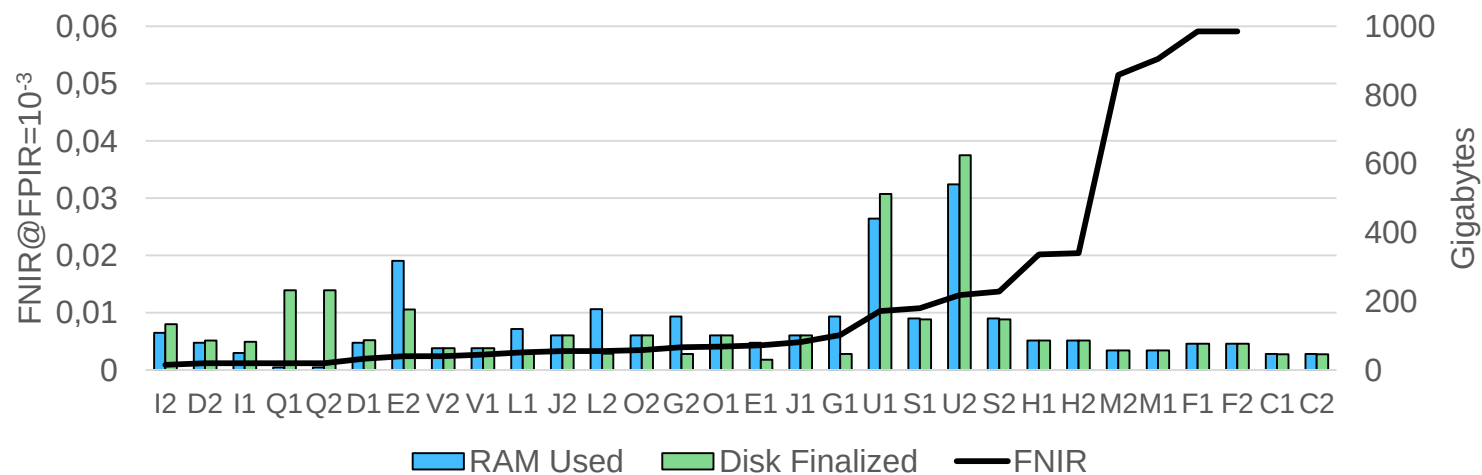
Data Source: FpVTE 2012 report, Table 18, 19

Template Size and RAM Used

Class A - Two finger (searched against 1.6 million subjects)



Class B - Ten finger IDFlats (searched against 3 million subjects)



Data Source: FpVTE 2012 report, Table 21, 22

Conclusions

- Ten Fingers are most accurate
- The absolute fastest submissions are not the most accurate
- *BUT, submissions are clearly tunable between accuracy and speed*
- *AND high matching accuracy can be achieved with fast search times*



Theoretical Use Case

Categorizing the Overall Performance

top performers

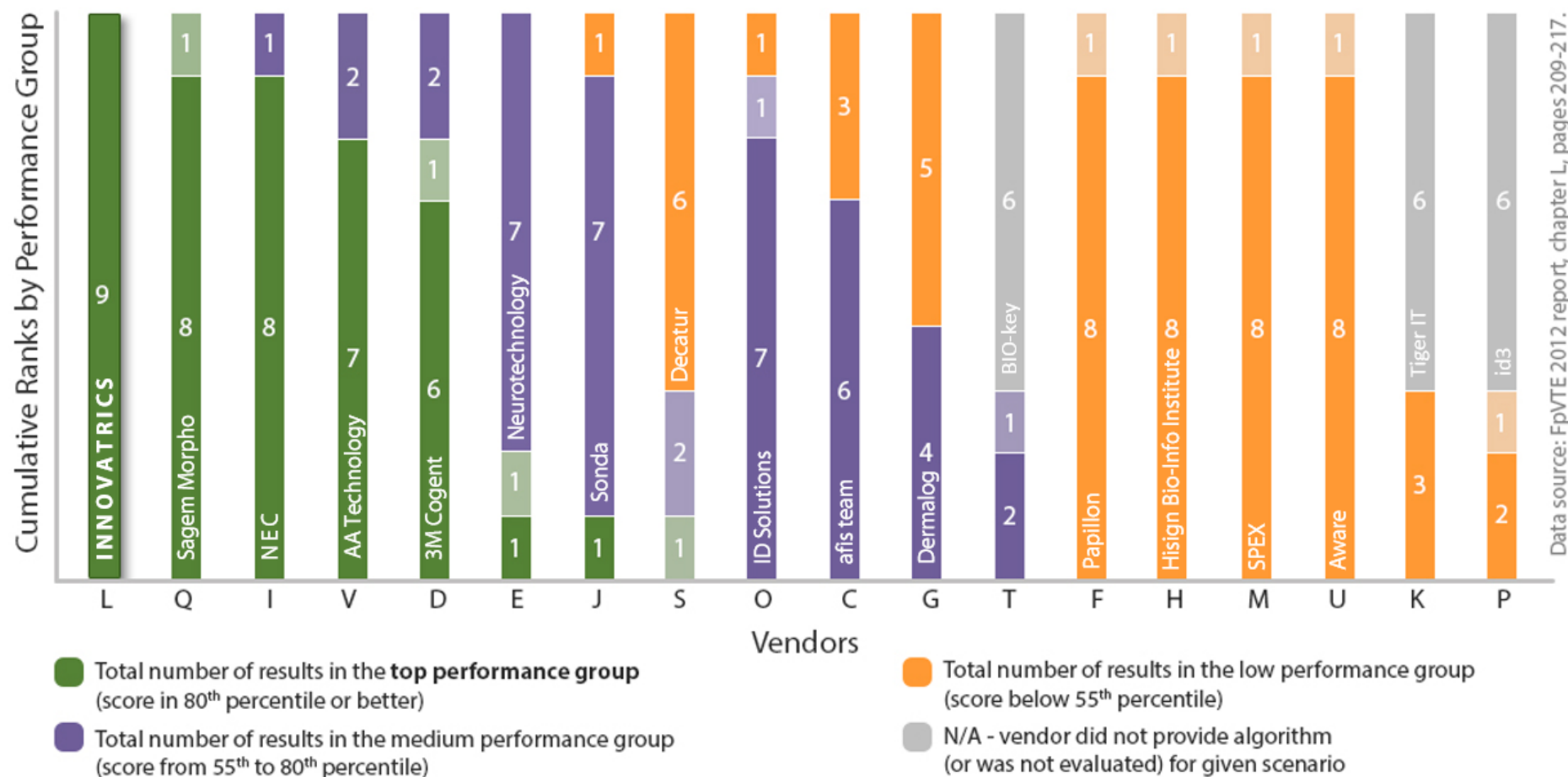
medium performers

low performers

Participant		Score	FNIR		Identification		Enrollment		RAM	
Letter	Sub. #									
I	1	132	2	0.0012	7	19.07	25	16.52	5	49.68
Q	1	129	2	0.0012	14	42.92	20	8.92	1	7.54
Q	2	119	2	0.0012	24	66.01	20	8.92	2	7.54
D	2	114	2	0.0012	18	46.70	24	11.86	13	79.43
I	2	109	1	0.0009	16	43.86	30	19.36	21	108.71
L	1	90	10	0.0031	5	14.50	2	3.05	22	119.79
V	2	83	7	0.0024	19	49.30	7	3.36	9	63.53
E	1	72	16	0.0043	2	6.76	13	5.34	14	79.73
G	1	71	18	0.0062	1	4.26	18	7.90	25	156.12
V	1	71	9	0.0027	10	34.96	7	3.36	8	63.53
D	1	52	6	0.0020	17	45.15	17	6.16	12	79.43
L	2	41	11	0.0033	9	28.59	1	0.88	27	177.48
O	1	39	15	0.0041	11	35.64	5	3.36	19	101.00
J	1	36	17	0.0049	8	25.38	3	3.35	18	101.00
O	2	31	13	0.0035	21	60.02	5	3.36	20	101.00
J	2	27	11	0.0033	22	60.13	3	3.35	17	101.00
E	2	20	7	0.0024	15	43.61	16	5.93	28	317.95
G	2	7	14	0.0040	6	16.26	18	7.90	26	156.12
M	1	1	26	0.0543	13	38.87	28	18.11	6	57.53
M	2	-8	25	0.0515	23	65.91	28	18.11	6	57.53
C	1	-8	30	NA	3	7.92	11	5.13	3	46.49
U	2	-17	22	0.0141	25	75.28	14	5.73	30	540.60
S	1	-18	20	0.0108	29	87.60	22	10.31	24	150.35
H	1	-19	23	0.0203	26	82.66	9	4.37	15	86.46
S	2	-20	21	0.0136	30	88.46	22	10.31	23	150.35
H	2	-21	24	0.0204	27	86.56	9	4.37	16	86.46
C	2	-28	29	NA	4	10.21	11	5.13	4	46.49
F	1	-29	27	0.0591	12	37.56	26	18.07	10	77.02
F	2	-33	27	0.0591	20	49.34	26	18.07	10	77.02
U	1	-49	19	0.0099	28	86.60	15	5.82	29	440.68

Data Source: FpVTE 2012 report, Table 96

Summarizing the Theoretical Use Case



Data source: FpVTE 2012 report, chapter L, pages 209-217.

Only higher ranked submissions from each vendor are reported. **Light color** means the result was achieved in the slow group (Submissions in Left index, Right index, Left and Right index finger search were split by NIST into fast group and slow group depending on whether the average search time was less than 20 s or more than 20 s).

Still to Come

- Larger search sets
 - 350,000 → 50,000 mate, 300,000 nonmate
- Lower FPIR
- Number of subjects in the enrollment set
- More analysis on failures
 - image quality, segmentation errors, gender differences, consolidation errors
- Two finger index compared to four finger slap
 - 4-finger IDFlat slap less accurate than 2-index finger single-capture images
- Speed-vs-accuracy track/competition



- Forensic Palmprint
- Mobile Data
- Cross-Comparison of Modalities

Thank You



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